




Article

The Human Digitalisation Journey: Technology First at the Expense of Humans?

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Abstract: The ongoing COVID-19 pandemic has enhanced the impact of digitalisation as a driver of transformation and advancements across almost every aspect of human life. With the majority actively embracing smart technologies and their benefits, the journey of human digitalisation has begun. Will human beings continue to remain solitary unaffected beings in the middle of the whirlpool—a gateway to the completely digitalised future? This journey of human digitalisation probably started much earlier, before we even realised. This paper, in the format of an objective review and discussion, aims to investigate the journey of human digitalisation, explore the reality of domination between technology and humans, provide a better understanding of the human value and human vulnerability in this fast transforming digital era, so as to achieve valuable and insightful suggestion on the future direction of the human digitalisation journey.

Keywords: human digitalisation; human value; human vulnerability; technology dependence; artificial intelligence; intelligence augmentation



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1. Introduction

As we enjoy and embrace the conveniences provided by adoption of technology in almost every aspect of human life, it is prudent for us to reflect more closely on the digital transformation of the world. The ongoing COVID-19 pandemic has accelerated the need for digital transformation [1] and forced businesses to operate digitally and shift all communications to digital platforms (thereby reducing contamination through touch points) as government-imposed lockdowns and hygiene-related concerns take precedence globally. Even before the onset of the pandemic, many industries (from automobiles to manufacturing to fashion) began their digital transformation process to leverage data/information for decision making, as competition is rife and digitalisation is mandatory for survival. Please note that the terms of digital transformation and digitalisation used in this paper are almost interchangeable and they both represent the process of embracing digital techniques/skills/platforms/tools and incorporating them into every step of operation.

The existing literature on those widely discussed terms like Big Data, automation, AI as well as their critiques are considerably established so we will not reproduce them here. However, to the best of our knowledge, there have been few academic articles specifically discussing the term “human digitalisation”. Therefore, in comparison to the substantial existing discussion and advancements on Big Data, machine learning and AI applications across different subjects, we would like to contribute this research discussing this emerging issue of the “human digitalisation” journey. Although this term is relatively new, it still closely connects to the wide discussion of AI and its critiques. A few key studies exist, for instance the recent material and political perspective discussion on AI and how AI centralises power by Crawford (2021) [2], the discussion of surveillance capitalism by

Zuboff (2019) [3], via looking at modern surveillance companies, like Facebook and Google, which actively embrace technologies in their activities, the modern power of information management by Andrejevic (2013) [4], the death of conversation due to wrongly equating connectivity with progress and dependency with digital technology by Turkle (2016) [5], the effects of digital mediums on the reading brain by Wolf (2018) [6], and a relatively early discussion of the impacts of internet on the way we human process information by Carr (2016) [7]. Some authors sought to capture the digital conversion of specific industries or sectors such as banking [8], manufacturing [9,10], tourism [11,12], health care [13,14], and education [15,16]). Moreover, there has been considerable attention paid to smart cities [17,18], smart buildings [19], smart grids [20], and smart agriculture [21], all of which are also closely connected to the human digitalisation journey. It is no secret that digitalisation has both positive and negative influences [22]. Some researchers have targeted certain business or economic process to reflect the influences of digitalisation, for instance as an enabler of a circular economy [23], as an enabler of risk control analytics within the supply chain [24], as a road map of business management strategy [25–27], and as the framework to enable better customer relationship management [28,29]. All of these inevitably influence different aspects of human life and play important roles in shaping the human digitalisation journey.

Given that digital transformations are primarily meant to be people-oriented, to better serve and improve the quality and efficiency of life, we find it important to take stock of the impact of accelerated digital transformation on human beings and their livelihoods to better understand how humans and technologies can co-exist without being threatened. In particular, we are interested in finding answers to questions like: What kind of positive and negative aspects of digitalisation taking place around us are we as humans aware of, since we continue to engage and benefit through the convenience and efficiencies offered by smart technologies? Are humans still leading and directing digital transformation or is technology backed by artificial intelligence (AI) making decisions on our behalf now? Through this perspective article, we aim to provide some reasonable answers to these questions by investigating the human digitalisation journey and will not only consider the progress, but also seek to identify the value and vulnerability of humans in this transformation process. Finally, we seek to present an insightful outlook that will give some indication of the future direction of this digitalisation journey and how humans and technologies could co-exist in harmony.

2. Digital Transformation and Digital Living

Several authors have put forward varied definitions of the concept of digital transformation [30]. Following an in-depth review, in [30] digital transformation is defined as “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies (p. 118).” To this end, smart technologies have significantly changed and impacted every aspect of human lives, from visible smart devices to invisible digital architectures (e.g., the cloud, platforms, and applications). Going digital is no longer a dream in the foreseen future but the present. Negroponte et al. (1997) [31] described digital life in the post information age, where information is personalised, obtaining information is efficient, space and distance are no longer obstacles, and machine to machine communications are possible to provide smarter services. Many of these predictions are now a reality in the modern digitalised world as evidenced by the convenient and intelligent features people frequently use on a daily basis. There is no doubt that the world has benefited a lot from such digital transformation and digital living as discussed and promoted by the abundant literature and other resources (see for example, [32–34]). However, the side effects of the human digitalisation phenomenon should also be gradually revealed as the digital transformation proceeds daily towards a new and more advanced level.

2.1. Google Effect

In an increasingly digitalised and connected world, reliance on search engines for answers to any question is a natural tendency. Google is widely regarded as the most popular search engine in the modern age with the company holding 71% of the search engine market share in 2021 [35]. Sparrow et al. [36] introduced the term “Google Effect” and addressed its influence on how people store, recall and access information/memory. People tend to enhance the transactive memory (recalling where to access information online) rather than the information itself. As such, digital devices and the internet serve as an external memory storage, an alternative for memorising information. Digital devices and the internet are used for recalling and uncovering information which can be easily found online, and a study by the Kaspersky lab shows that nearly 30% of people forget an online fact right after accessing it [37]. The transactive memory is reinforced every time you successfully and conveniently retrieve information from external storage (e.g., searching engine web sites and/or smart devices), and it is now more convenient to use external information storage rather than creating space within our own memory for such information. Realising the economic potential of this behaviour, some companies exploit such technologies to enhance the productivity of human tasks and thereby further contribute towards the increasing dependency on the internet and technology.

2.2. Internet/Technology Dependency

As the “Google Effect” influences how humans memorise, store and access information, from the cognition point of view, studies confirm the significant internet- and mobile technology-related cognitive impacts and structural changes in the brain [38–40]. Loh and Kanai [41] stated that technology-empowered digitalisation tends to promote “shallow” information processing behaviours characterised by rapid attention shifting and reduced deliberations, which are closely associated with multitasking behaviours with increased distractibility but poor executive control abilities. Such negative and lasting impacts on cognition functioning mean that it is becoming more difficult to memorise, concentrate, “deeply” process information and regulate emotion [38]. The consequences of internet and technology dependency could lead to serious addictive behaviours. Researchers [42–44] have discovered the same kind of brain network abnormal behaviours as identified when one is suffering from addiction to other substances like alcohol and drugs. Their findings suggested that internet and technology dependency (or addiction disorder) can cause disruptions of functional connectivity and structural alteration of the brain, which could further aggravate behavioural impairments.

Regardless of the potential cognition dysfunction and addiction disorder, the increasing digital transformation of the world we are living in means it is almost impossible to spend less time on the internet or with different smart devices. Companies are aggressively exploiting digital technologies already, even though many concepts are yet to present their competitive advantages comprehensively. Is this driven by the fear of being left behind, or is it because companies now acknowledge that the progression of a digitalised future is unstoppable? Either way, as internet and technology usage accelerates, it is important for humans to bear in mind the associated negative side effects on cognition and behaviour. Humans should reflect on such dependency and focus on the justified usage of technology as a means to boost productivity and efficiency, rather than allowing social norms to take over this transformation at the expense of behavioural impairments and addiction disorders. Given that technologies and smart devices are programmed to provide convenient services, humans become attracted and attached to these easily. Yet, it is crucial that we address the value of humans in this process, both now and in the distant future as artificial intelligence (AI) could replace the human mind if it is not carefully managed. Therefore, discussing and reflecting on the role and purpose of digitalisation through the AI and intelligence augmentation (IA) lenses are mandatory [45].

3. Human Value in the Era of Digitalisation

Just like the double edged sword character of science and technology, as was acknowledged in [46], the abnormal dependency or over reliance on technology could lead to more damage than benefits, especially, in terms of the significance of human value in the digitalisation process. The value placed on humans receives differing treatment in the era of digitalisation. Reliance on smart devices and technologies for day to day tasks replaces the efforts of the human brain on the development of the neural circuits and enhancement of cognition, which in turn gradually diminishes neural capability whilst reinforcing over-dependency [46].

There is no doubt that the era of digitalisation promotes outstanding scientific advancements in terms of all sectors of the economy, and health care, to culture, and education as a result of the boost in AI technologies. However, there are also concerns regarding the possibilities of AI exceeding human intelligence and capabilities [47]. In a report by the Pew Research Center [47], such concerns and suggestions were summarised, and those interested are referred to that report. An important aspect we interpreted from these concerns expressed by nearly a thousand technology pioneers and experts is that the human value is losing its appreciation in this process as a result of adopting technology to improve the convenience and efficiency of our daily lives. Smart technology requires less or even no human input in the process. Thus, the question remains as to whether this gives us more control over our life or whether we humans are in fact been given less choice as determined by a machine and losing the power to control our choices? Therefore, the status of human value in the digitalisation process could be the key to determining the direction of the two completely different worlds ahead.

Given that the ongoing digital transformation covers not only cutting edge technologies but also our daily tasks, it is not the aim of this paper to defame technology advancements. Instead, it is aimed at communicating the importance of retaining human control and prioritising human value as we progress with the development of AI technologies. In fact, it is its advancements and benefits to the global society that attracted our attention to investigate this journey of progression.

We believe finding the best solutions for retaining human control and prioritising human value will not slow down such transformation, but promote its long term sustainable development while retaining human trust and preventing negative side effects. Only when human value is truly prioritised in this context will incorporating smart technologies create sustainable benefits in terms of improving human to human experience and optimising human living. When human value is overlooked, the ethics of smart technologies could be questionable, let alone their advancements in improving human to human experience.

In terms of concerns around ethics, as Jeff Robbins once said: “the greatest disadvantage of dependency on AI is dependency on AI” [48]. The common aim is to increase the dependency on smart devices, technologies and applications for those who are behind the scenes working on developing and marketing them profit wise. It seems ethically questionable especially when those technologies potentially neglect the cognition function, contain conscious or unconscious biases, and lead to misuse of the cognition dysfunction for promoting additive dependency on those smart applications and devices. There are continuous concerns on the ethics of smart technologies, supported by a number of studies investigating different ethical aspects. Specifically, Jobin et al. [49] summarised the five ethical AI principles emerging globally as: transparency, justice and fairness, non-maleficence, responsibility, and privacy. A very detailed and comprehensive review of AI ethics issues and guidelines can be found in [50], which we do not reproduce here. Among all the emerging ethical issues summarised, concerns that are related to prioritising human value (like human control, human oversight and human autonomy) are not among the ones which received the most attention. In fact, the public focus tends to remain around privacy, security, justice, and transparency. To some extent, this reflects that current development and digitalisation transformation appears to be neglecting the human value and its significance within the overall process. Like empathy, curiosity, courage, instinct, imagination,

emotional intelligence, innovation and creativity, those values that cannot be digitalised and replaced by smart technologies are the keys of human value in the era of digitalisation, and according to the report by PwC's Chief Economist Office [51], human values could be the determinant of reaching the highest potential in the digital age.

4. Human Vulnerability in Technology Evolution

As human values are found to be the key determinants of success in the era of digitalisation, in this section we aim to investigate those aspects of human vulnerabilities in the process of technology evolution. Successfully identifying such human vulnerabilities could lead to better understanding of the areas/subjects where human values are not truly appreciated in the current digital age. Meanwhile, those identified areas will also to some extent reflect the mainstream concerns around smart technology and digital transformation on scale. These in general will help to expose the problematic "short planks" of the "digitalisation barrel", which has no objective of opposing digitalisation and smart technologies but, on the contrary, aims to give insightful direction on finding the better path to digitalisation while prioritising human value and preventing human vulnerabilities.

4.1. Full Automation Replacing Human

Machines were initially designed for improving the efficiency, accuracy and productivity, so that human resources could be freed up from labour intensive or repetitive tasks to other more intelligent tasks. The journey of automation has come a long way with the majority welcoming and embracing its advancements. However, concerns of full automation replacing humans are rapidly emerging, especially over the recent decade, as technologies have made automation smarter, so more jobs are at risk of being replaced. The purpose of automation appears to be consistent with the aim of improving productivity, however more intelligent automation inevitably means that humans will be pushed to even more intelligent tasks, or tasks that cannot be easily programmed or handled.

Machines and robots are sufficiently smart to make certain informed decisions with highly minimised levels of inaccuracy. As such, human efficiency and productivity is no longer comparable with super automation platforms. The scale and intelligence of automation is also growing rapidly and advancing whilst we may not be able to say the same about the development of intelligence in humans. This fear of being replaced could be fundamentally motivated by the limited opportunities for majority of the labour force to develop skills surrounding intelligent tasks at the same speed as the development of automation due to a lack of resources and support.

Many of the former advantages of humans in relation to automation, such as personal judgement and flexibility, have been weakened and replaced by automation as smart technologies enable machines to learn and be programmed to process more complex information and handle more complex tasks. Nowadays computers can even diagnose situations and identify challenges that humans do not see [52]. Therefore, it is not entirely surprising that there is a growing fear and concern among humans of being replaced, as it is likely that many "digital native" generations may not know or understand what underlies the scene of smart automation. If this emerging concern is not addressed properly, it would result in a long term defective employment relationship as an emotionless market transaction [52]. The ethics of automation in replacing the human labour force, and responsibilities of employers/companies in this aspect are key to addressing this emerging concern and protecting human vulnerabilities.

4.2. Human Agency vs. Machine Agency

Humans tend to have blind faith in technologies. Researchers in [53] discovered that people with higher levels of machine heuristics tend to trust computers more than other humans, especially when regarding our personal information, likely driven by the impression of machines being lawful, honest and not containing selfish motivations. Powerful media platforms are designed to exploit that trust and bring more convenience and information

to our life to assist with decision making in general [54]. Therefore, it seems natural that we tend to use smart navigation applications to direct us to a specific location, check the product reviews before we purchase goods, go to popular/recommended restaurants based on Google reviews/yelp/or other media platforms.

However, it cannot be generalised as applicable to everyone. For example, your navigation app consistently leads you through another route whilst with your local knowledge you might actually prefer to take a different path. Furthermore, you went to a “popular” cafe/restaurant recommended online, but later you discovered that even a random food cart on the street serves better food. A highly reviewed company turns out to be providing poor quality service. The popular and trending products on media platforms look great in nice photos but are not practical for daily use. Somehow you have to Google the postcodes of locations every time (even the ones you visit regularly). Without your smartphone, it seems impossible to call your closest friends or remember their birthdays, as you simply do not store their numbers or date of birth in your own memory. These are few examples how over reliant we are on technology. Sundar [55] referred to such phenomena as the rise of machine agency, as machines become more agentic and media experiences become increasingly determined by algorithms. Human agency on the other hand is weakened [47]: more humans lack knowledge about what underlies algorithms, or do not learn the context about how these work and decisions are reached; people sacrifice independence, privacy and power over choice, and have no control over these processes. Such negative effects and self-inflicted vulnerability of humans will only keep emerging as smart technologies and AI-led platforms continuously advance [56].

Leonhard (2016) [57] in his book specified such tension between human and machine agency as the coming clash between man and machine, the match between humanity and technology. He suggested that one should not trust technology entirely but treat it as yet another option which can be exploited. Sundar [55] also called for emergent collaboration between humans and machines in negotiating the type and degree of agency, where machine agency enhances human agency rather than threatening it. As was stated by Leonhard [57], human emotions can not be programmed or easily altered. Therefore, it is prudent to involve humans in the change themselves, making sure they understand the reasons and mechanism behind the scenes so as to build up a healthy symbiotic relationship between humans and AI [55,58].

4.3. AI-Empowered Privacy Conscious Personalisation

AI-empowered digital transformations have enabled the offering of personalised media/business/service experiences for almost every aspect of our daily life. Based on a consumer’s location, search interest, purchasing history, other account or relevant personal information, companies target consumers through location-based marketing and personalised advertising. Given the enhanced personal touch, these initiatives lead to higher influencing power and marketing effects. However, such personalisation has also raised concerns regarding privacy, and the ethics of misusing such information with profit-driven or other selfish agendas.

The amount of information that is collected and shared across applications/media platforms is surprising regardless of the unreasonably complex settings of sharing and collecting cookies, history, and privacy consent. Whilst applications appear to be rather straight forward and prompt us to give access to all information in most instances, on the contrary, it is a very tricky process/operation/setting if you would like to fully protect your own information and privacy without giving consent to some kind of data collecting, tracking and sharing activities that occur behind the scenes. After extensive tests on nearly 560 websites, researchers have discovered that a significant amount (54%) of websites contain suspected unlawful violations [59]. Another group of researchers in [60] scraped the designs of the top five consent management platforms on the top 10,000 websites in the UK and discovered that nearly 90% do not even meet the minimum requirements based on European law.

Despite the problematic privacy and data protection issues some consumers continue to trust and give consent to have their information accessed. Yet, it is frustrating to discover that further down the line, those same consumers encounter unethical problems like algorithmic pricing and targeted advertising [61,62], where customers could lose access on those products and information that are not “programmed” to be “useful” to them. This may even apply to actually losing out on better options or even cheaper deals. The digital native generation may be able to break through this personalised marketing/pricing circle and safeguard their own interests, but how about those who fundamentally lack knowledge on this digitalisation process? Are they in fact losing their freedom of choice and privacy? It is not surprising that tech giants would tend to invest and develop on areas with potential huge profits for themselves. However, whether this can also benefit their customers or whether they treat customers only as the source of profit is an emerging ethical question, and this crucial question would require much more attention from not only academics, but also digitalisation practitioners as well as policy makers.

4.4. Digital Media Depression

Social media platforms are now deeply embedded into our daily lives through how we communicate and fit into society in the digital era. These intelligent platforms aim to simulate real society/community and promote convenient information sharing and communication. However, there have been many studies on the close association between media/technology use and anxiety, depression, self-harm and suicidal behaviours, especially among young children [63–65]. Such negative effects on mental health due to increasing technology use could be the results of: lacking in-person emotional communication and social interactions; lack of sleep time, changes to sleeping patterns and quality; online/social media environments with problematic or improper values, and social anxiety from worries about being inadequately connected. More recently, Alabers et al. [66] have identified a connection between passive social media use with depression symptoms. Keles et al. [67] also confirmed a correlation between depression, anxiety and psychological distress with different domains of social media use (including time spent, activity, investment and addiction).

Due to the COVID-19 pandemic, many have now significantly increased their screen exposure time as well as technology usage through different digital platforms. Researchers have discovered that the increased screen exposure and digital media use are closely associated with disoriented sleep patterns, lack of a sense of time, emerging mental health issues as well as somatic pain [68,69]. Our significant reliance on digital platforms and smart technologies nowadays is partly due to the digital transformation of almost every aspect of our daily life, but another important determinant is that many media platforms are designed intentionally to reinforce us to conduct shallow information processing and promote passive usage, which is closely connected to the technology dependency we previously discussed in Section 2.

4.5. Digital Divide and Exclusion

While the digital natives happily embrace the majority of smart platforms and technologies, globally there remains a significant proportion of people who live isolated or far behind from the digitalisation transformation process, as many are fighting against hunger and poverty. According to a UN report, almost half of the world’s population has no access to the internet, and only a few countries are exploiting the frontier edge of technology advancements. Such a digital divide [70–72] between developed and less developed countries/regions, rich and poor, men and women, younger and elder has increasing negative effects on the deterioration of the already existing inequalities in general [72], as well as the aggravation of the digital divide leading to increased digital isolation. Digital divide is a relatively inclusive term, it refers to a few different layers [72]: the physical access to digital resources and devices, the digital skills and usage, the outcomes of using or not using digital media. Despite the continuous efforts of global organisations, governments and

local communities in bridging the digital divide, especially in engaging the poor, elderly and other digitally disadvantaged groups [73,74], we still observe the growing divide in different layers.

As COVID-19 drove the majority of activities like education, communication and non-essential work to digital platforms (thereby enabling remote working), numerous existing issues pertaining to the digital divide (which have existed and accumulated for a long period of time) suddenly exploded and required the urgent attention of society at a global scale [75,76]. It came under the spotlight that there are still many children/families (even those living in developed countries) who do not have proper internet access or access to smart devices. Furthermore, a considerable number of elderly people struggle with proper digital skills to conduct daily errands. Holmes and Burgess [77] noted a clear link between poverty and digital exclusion in the UK and its catastrophic effect on the deep inequalities. The lockdowns associated with COVID-19 have turned the problem of digital exclusion into lost education and opportunity for those poorest and most vulnerable.

On the surface, addressing the fundamental layer of the digital divide (i.e., physical access) appears to be relatively straightforward. Governments and global organisations have been working on increasing the digital infrastructure capacity, enabling more affordable smart devices and their access to those digitally disadvantaged, levelling the play field in between digitally advanced and vulnerable regions/countries, as well as mitigating the uneven digital resource distribution. However, as the digital divide and exclusion deepens and widens different facets of the deep inequalities, solving the physical access gap alone is no longer sufficient. Those who are digitally vulnerable will need more support and guidance on the digital skills to properly make good use of such equipment and technologies. Thus, it is important that initiatives are conducted to better explain the underlying technical details of smart technologies and algorithms so that these are better understood by the majority of people, including those digitally disadvantaged, as that will be the key to addressing the issue of the digital divide [78–80].

5. From AI to IA—Humans First and Technology Second

In this paper, we have explored the digital transformation and its implications on human digital living and digital thinking, which we refer to as the journey of human digitalisation. The dependency on technology has reinforced the need for us humans to re-think our digital behaviour. We tend to use digital platforms and devices as the external storage of information rather than memorising them by ourselves, we are acclimatising to shallow information processing and passive usage of media platforms to quickly obtain and process information; we rely on the review and information produced by programmed intelligent machines to make decisions and coordinate resources. Such reliance on smart technologies is partly inevitable given the rapid digital transformation of the world we live in, but it is also driven by the initial design of such intelligent platforms where human values are overlooked and humans lost control over choices and privacy. Negative side effects of increasing dependency on smart technologies are emerging under the spotlight, from cognition dysfunction, addiction disorders to mental health issues like anxiety, depression and self-harm and suicidal behaviours. How fast should the human digitalisation journey progress and for how long should we continue to ignore the consequences before it becomes too late in this journey? There is a crucial balance we must urgently consider and put into practice. Past literature of critiques against AI may have made a group of people aware of such consequences. However, the awareness and attention is still unbalanced in comparison with the rapidly growing trend of digital advancement. Considering the emerging side effects, not to mention the boost of digitalisation due to COVID-19, we believe it is important to emphasise this crucial issue again via reviewing more recent literature and developments, and we hope this discussion can serve as an up to date further supporting study to existing studies and a reliable resource for interested readers nowadays in comparison with media articles.

In terms of the future, when the world is completely digitalised, it is concerning as our discoveries so far indicate that humans would find it difficult to remain unaffected by the increasing negative aspects of digitalisation. We discussed the importance of appreciating and incorporating human value into the digital transformation process and how prioritising human value can assure the control and advantage of human agency in comparison with machine agency. Such efforts would help improve human to human experience, prevent or minimise negative side effects, and promote sustainable digitalisation transformation. We also investigated the human vulnerabilities and emerging issues like concerns of full automation replacing humans, the match between humanity and technology (human agency vs. machine agency), the problematic privacy and personalisation paradox, depression and mental health concerns due to digital and media usage, and the growing digital divide and exclusion which adds mounting tension on inequalities.

The human vulnerabilities we have exposed in the process of digital transformation sound alarm bells and it is unwise to overlook those signals. It is crucial to set clear boundaries about privacy and ethics in digital living and protect digitally vulnerable people. This links with the need to bridge the digital divide and reduce digital exclusion, especially for those poorest, young and elderly, and other disadvantaged groups. There is an urgent need to provide wider and easier access to internet and smart devices, to support and educate on digital skills so as to make better use of smart technologies, to popularise the skills of programming, and increase algorithm awareness while maintaining the appreciation of prioritising human value. This will protect humans from vulnerabilities and contribute towards a sustainable cycle of advancements that can establish and create symbiosis between AI and humans [58] such that they share similar value such as in the human–AI synergy proposed in [55] and intelligence augmentation (IA) discussed in [45]. In conclusion, we believe that ethical AI should be a tool for intelligence augmentation, where human values are prioritised, human agency and freedom of options are valued over machine agency, AI is considered merely as a tool and option for improving the efficiency of human intelligence. Collaborations of that nature between humans and AI will promote coexistence and increase human value awareness, assure better user experience of smart technologies and trust in AI, as well as prevent the deterioration of human vulnerability in the rapid technology evolution. The human digitalisation journey may have fast progressed with some challenges and side effects along the way, but we believe identifying the correct direction and promising pattern of coexistence will help prevent further negative consequences and secure human interests in the digital world.

We understand the current paper as a short review and the discussion may well not be linked to all related disciplines considering the amount of subjects this emerging issue covers; it is also challenging to comprehensively discuss all related disciplines and the literature in one article. Therefore, we aim to extend this paper to a larger research project as our future research direction, where we would like to further explore and conduct a comprehensive interdisciplinary investigation of this emerging issue in the format of a series of papers/book chapters by specific discipline.

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